are faced with the impossible case of *three* exclusive alternatives all as likely as not." It appears to us that each of these estimates is based on different evidence, and, therefore, that it is quite possible that the sum of the probabilities should be greater than unity. A person who could recognise only one colour, say, blue, all others appearing alike to him, would estimate the probability that the book is blue at $\frac{1}{2}$. A person who could recognise only red would make a similar estimate for red. But one who could distinguish red, blue, and black, and no others, would estimate each as having a probability of $\frac{1}{3}$. In each case we follow the author in assuming no previous knowledge of the proportions of different colours among books.

The point is worth insisting upon, for we believe that the author has for such reasons refrained from estimating prior probabilities in many cases where such estimates would have been useful. In his discussion of sampling inference, for instance, he refuses to admit that any plausible estimate of the probable composition of a sample can be made, however large a sample has already been examined, unless we have further evidence that no disturbing cause exists. Admittedly the inference depends on the prior probabilities of different compositions, but we have shown that in ordinary cases a wide range of variation of the prior probability produces little variation in the inference made with regard to the composition of a large sample, and we think this is the only justification required. The acquirement of knowledge about a disturbing cause provides additional data and is valuable for that reason; its absence is no reason for denying a probability inference not based on it.

The author's insistence on the desirability of careful testing of the sample to see whether different subclasses from it have compositions similar to the whole is, however, very important on other grounds, for his careful discussion indicates the precise usefulness of a kind of additional information that is often obtainable and valuable. His conclusion (p. 426) that "sensible investigators only employ the correlation coefficient to test or confirm conclusions at which they have arrived on other grounds" is an exaggerated statement, but perhaps a salutary one.

A form of the frequency definition is discussed and rejected on the ground that it does not give any basis for induction. According to this the probability of a proposition p on evidence q is to be obtained by selecting a large number n of instances of q. If m of these are also instances of p, the probability of p given q is defined to be m/n. This theory is taken too seriously; it would be sufficient objection to point out that, unless m/n is 0 or 1, the probability would necessarily be changed by having $n+1$ instances instead of n, and would therefore be conventional. In the form of the frequency theory discussed (and also rejected) in our paper the probability is defined as the *limit* of this ratio when n tends to infinity. This view, though it has been seriously advocated, is not mentioned by the author.

The faults attributed to the book above are all on the side of excessive caution, and the positive contributions are extremely valuable. It is clearly written, with a good index and a copious bibliography. The misprints are few. Whitehead and Russell's "Principia Mathematica" is, however, mentioned a few times as if it were by a single writer. The work should be read by every student of science who aims at a real understanding of his subject.

HAROLD JEFFREYS.

The Royal Society Catalogue.

Catalogue of Scientific Papers, Fourth Series (1884–1900). Compiled by the Royal Society of London. Vol. 17, *Marc–P*. Pp. v+1053. (Cambridge: At the University Press, 1921.) 9*l*. net.

THE high standard set by the volumes already published in this series is fully maintained in the seventeenth volume of the Royal Society's "Catalogue of Scientific Papers." The work of preparing the material for the press and of proof-reading was carried out by Miss Vagner and Miss Barnard, and until December 1920 Miss Chapman was also engaged upon the work. The Cambridge University Press is to be congratulated on the typographical excellence of the volume, the small type which had to be used being quite easy to read.

The papers indexed are those published during the seventeen years 1884 to 1900 by authors whose names begin with the four letters M (from Marc onwards), N, O, and P. No less than 10,662 names are indexed, the number of separate papers being 57,474. Thus, on an average, each author has published one paper every three years. The volume brings up the total number of authors' names already printed for the period 1884–1900 to 49,750, and the total number of entries of papers published by authors whose names begin with letters from A to P inclusive to 279,902. The catalogue of papers by authors whose names begin with letters from Q to Z is still to be published.

The Committee say that the difficulties in the printing and publishing trade, which for a time delayed the regular delivery of proofs, have now been overcome, so that they look forward with

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confidence to an early completion of the remaining volumes. When these are published the gap between the "Catalogue of Scientific Papers" and the "International Catalogue of Scientific Literature" will be filled so far as the index of authors' names is concerned; the indexing of scientific papers under authors' names will then be complete up to 1914.

There will still remain the subject-index, of which we believe only the volumes for mathematics, mechanics, and physics have been published, and that some fourteen volumes have yet to appear. To most of us a subject-index is much more useful than an author-index. While an author-index is essential as a permanent record of work done by individual authors, it will be of little use to an investigator anxious to discover what has previously been done in a particular line of research. For such a purpose a subject-index is required. We therefore hope that the Royal Society will proceed with the production of subject-indexes for the period 1800–1900 on the plan already begun with such success.

In addition to the surname of the author, the "Catalogue of Scientific Papers" gives the full Christian names so far as these can be ascertained. This is not merely in order to give credit to those to whom it is due, but also to make it easy for those who refer to the catalogue to distinguish between an acknowledged master of a subject and a little-known author who may chance to have the same surname. We commend the printing of titles in the original language, followed, when necessary, by an English translation. Those who have attempted to render a foreign language into English know how difficult it is to convey the exact meaning of the author; it is better, therefore, to let him speak for himself. In some of our abstracting journals we may find titles of foreign papers not only translated but so altered that no one could reconstruct the original. Nevertheless we think the compilers of this volume would have done well to add the English equivalent of some of the titles which they have printed without a translation. This would apply, for example, to many papers published in Swedish.

The Royal Society, representing, as it does, all branches of science, is clearly the body best able to carry to a successful issue any work indexing the whole field of science; all who take an interest in science will therefore feel that they owe the Society a debt of gratitude for having undertaken the great work of making a complete catalogue of the scientific papers published during 1800–1900 and for showing its intention to continue the work to a successful issue. A monumental work of this kind will never be out of date, but will be treasured as a permanent record of the marvellous achievements in the domain of science during the nineteenth century.

Our Bookshelf.

Handbuch der biologischen Arbeitsmethoden. Edited by Prof. Dr. Emil Abderhalden. Abt. 5, *Methoden zum Studium der Funktionen der einzelnen Organe des tierischen Organismus.* (1) Teil 3, Heft 1, *Entwicklungsmechanik.* Pp. 218. 66 marks. (2) Teil 3, Heft 2, *Entwicklungsmechanik.* Pp. 219–440. 72 marks. Abt. 9, *Methoden zur Erforschung der Leistungen des tierischen Organismus.* (3) Teil 1, Heft 1, Lieferung 34, *Allgemeine Methoden.* Pp. 96. 30 marks. (Berlin und Wien: Urban und Schwarzenberg, 1921.)

(1) THE five articles which form this "Heft" are concerned with the technique of experimental embryology. In his account of micro-surgery Prof. Spemann deals with the operations for the examination of eggs—for dividing them either incompletely, *e.g.* by means of a looped hair, or by actually cutting the egg into two—with transplantation of parts of embryos to unusual positions, etc. Prof. Barfurth discusses the technique for the inquiry into heteromorphosis and regeneration in various groups of animals—embryos as well as adults. In this part Fig. 48 is printed without reference letters or description. Prof. H. Przibram gives methods for investigating the influence on development of heat, light, gravity, etc.; Dr. Karl Herbst deals with the methods of modifying development by means of various salts in solution, and Dr. Neumayer describes the instruments and technique of a number of operations. The work forms a useful source of reference for research workers and advanced students who desire to ascertain the methods which have been most successful in practice.

(2) The memoir by Prof. Rhumbler deals with the methods of imitating or producing "models" of living processes by physical devices—*e.g.* amœboid movement, the ingestion of food as by an amœba, the formation of a test as in the Rhizopoda, cell-division, fertilisation, etc. The volume is a helpful and concise contribution to the literature of the physics of vital phenomena.

Both these parts would have been improved if they had been provided with an index or a table of contents.

(3) In this, the first article of a new volume, Prof. Przibram gives many useful suggestions as to the methodical beginning and carrying through of research in experimental zoology. The selection and clear statement of the problem to be attacked, the economical use of living specimens —and also of time—by carrying out, wherever possible, more than one line of research on the same

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